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Light My Fire: The Use & Policies of Woody Biomass as a Heat Source

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by Carla Santos & Alisha Falberg***

Introduction

In a carbon–constrained world, the United States ("U.S.") is facing the serious challenge of mitigating climate change through the adoption of federal and state policies and legislation. While transportation and electricity have been hot topics in many debates to address climate change, heating is often left to the margins of policy discussions without clear reason. Accounting for nearly one-third of all energy consumed in the country,[1] heating is a major source of greenhouse gas ("GHG") emissions. This is especially true in the Northeastern region of the U.S., which is highly dependent on non-renewable fossil fuel sources to provide heat.

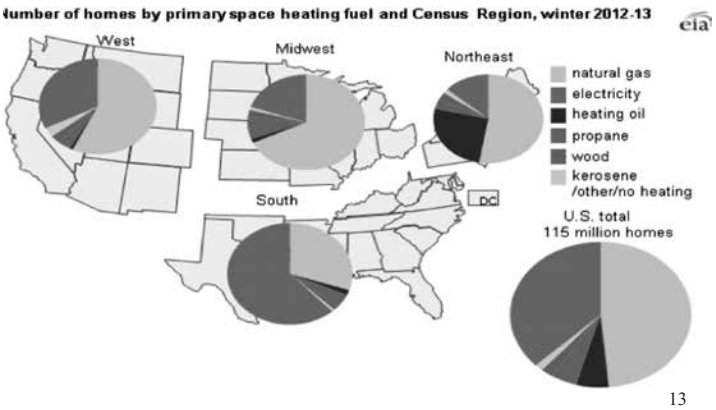
This paper will address the need to include heat produced from woody biomass within the energy sector that should be targeted by the federal and state climate change policies. Using the Northeastern states as a starting point, this paper advocates for the adoption of laws and regulations that incentivize the use of renewable sustainable energy sources for heating, in particular woody biomass. To begin, the following section will provide a brief overview of the history of heating in the U.S., providing the necessary background information to support the case of federal and state intervention for heating policy and standards. This paper will then present the major environmental concerns regarding the use of woody biomass as an energy source, especially for heating. Succeeding the environmental concerns, we will discuss the current relevant energy policies relating to the use of woody biomass for energy and heating. This paper then looks to Canada and the lessons learned from its developed woody biomass industry. The final portion of this paper proposes recommendations of actions to be adopted by federal and state governments, particularly in the Northeast region.

Heating in the U.S.: The Missing Piece in Climate Change Policy

Energy use is typically divided into three different primary functions: transportation, electricity, and heating and cooling. Energy consumption for electricity and transportation is widely debated, and several mandates have been adopted addressing some of the concerns related to the high dependence of those sectors on fossil fuels. At the federal level, Renewable Fuel Standards ("RFS") have been in place since 2005, which require a specific amount of renewable energy fuel to be blended into gasoline,[2] addressing some of the concerns regarding transportation sources. In the electricity sector, several states have adopted progressive measures to ensure the deployment of renewable energy sources to meet demand. One example is the adoption of Renewable Portfolio Standards ("RPS"), which requires "electricity suppliers (often referred to as 'load serving entities') in a given geographical area to employ renewable resources to produce a certain percentage of power by a fixed date."[3] According to U.S. Energy Information Administration ("EIA"), thirty states and the District of Columbia have adopted mandatory RPS, while another seven have adopted voluntary renewable goals.[4]

Despite efforts to address the high dependency on fossil fuels in the transportation and electricity sectors, heating and cooling has been cast to the side. Often referred to as the "missing piece"[5] of the climate change mitigation policy, heating plays a major role in overall energy consumption.[6] In the U.S., heat accounts for one-third of all energy consumed.[7] In the Northeast these numbers are even greater; nearly thirty-nine percent of all energy consumed in the region is used for heating, which in 2007 represented 2.09 quadrillion British Thermal Units ("BTUs").[8] In the residential sector, space heating accounted for 41.5% of all energy consumed in American homes in 2009.[9]

Primary heating sources vary across the country. Natural gas, for instance, has a huge share of the heating market, providing heat for fifty percent of American homes.[10] However, the Northeast region presents a unique situation representing nearly eighty percent of U.S. households—5,520 households[11]— that rely on oil to heat their home.[12]



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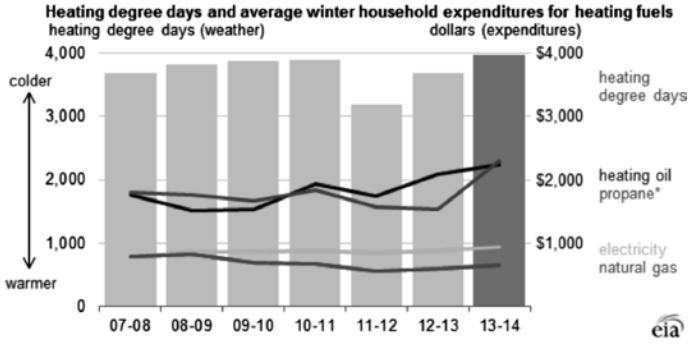
Various sources could replace this dependency on oil, such as: "natural gas, electricity, bottled propane, and wood."[14] Natural gas, however, depends on transmission and distribution pipelines,[15] the limitations of which become more evident during the winter when all pipelines coming into New England are constrained.[16] Also, despite being considered a cleaner source when compared to heating oil, natural gas is a non-renewable fossil fuel energy source, contributing significantly to GHG emissions. Electricity, seen as an attractive alternative due to its relatively low price also has drawbacks in the Northeast. For example, Vermont is facing the challenge of finding substitute electricity sources for roughly one-third of the electricity consumed in the state after the decision to retire the Vermont Yankee nuclear power plant by the end of 2014.[17] The third alternative, propane, is not considered economically viable since its prices are higher than other sources and highly unstable.[18] When compared with electricity and natural gas prices, which have been roughly the same or slightly lower than propane since 2007, the use of propane makes less fiscal sense.[19]

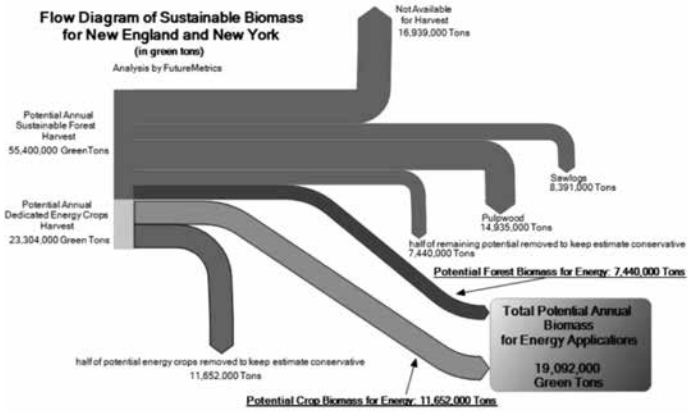


This leads us to the world's oldest energy source: wood. A well-known part of human history, woody biomass was the primary source of energy for American families for several decades.[20] Displaced by the increased use of coal and fossil fuels at the beginning of the nineteenth century, [21] wood is once again viewed as an attractive renewable energy source, especially for heating in the Northeast states.[22] The potential of wood is already being recognized around the country. In 2011, the U.S. consumed over two quadrillion BTUs from wood energy;[23] twenty-two percent of all the renewable primary energy consumed in the country.[24] Heating was responsible for much of this consumption. With a thirty-nine percent increase since 2004 in the use of cordwood and wood pellets for residential space heating, 2.5 million households used these sources to heat their homes in 2012.[25] Around New England,[26] twenty percent of the homes relied on wood for space heating, water heating, or cooking in 2009.[27]

Despite these findings, much needs to be done to implement a real renewable heating policy in the U.S. Currently, a national initiative has not been adopted establishing targets or renewable standards to address the heating sector's high dependency on fossil fuels. In fact, the latest National Climate Action Plan[28] presents a number of actions to be adopted in 2015. While the electric and transportation sectors are often mentioned, there is no explicit reference to heating found under the actions section presented in the report. The same can be seen in the introduction letter to the plan presented by Secretary of State John F. Kerry, which only refers to electricity, transportation, and efficiency results over the last years:

> Under President Obama's leadership, we have doubled wind and solar electricity generation; adopted the toughest fuel economy standards for passenger vehicles in U.S. history; advanced environmental standards to expedite the transition to cleaner and more efficient fuels in power plants; and increased the energy efficiency of our homes, industries, and businesses.[29]

Using the Northeastern states as a starting point, this paper asserts that the increased use of woody biomass for heating is key for renewable energy policy in the U.S. for three reasons. First, U.S. high dependency on oil to heat homes, especially in the Northeastern states, must decrease. Second, woody biomass has the potential to be a truly renewable resource because the supply potential across the country is great. In the Northeast states, this possibility is even greater as the "nation's most forested region."[30] New England's six states, for instance, have as much as thirty-three million forest acres of its forty-two million acres—roughly seventy-nine percent of its total area.[31] Studies show that the New England states, including New York, have the potential to provide an additional 19.092 million sustainable green tons for energy application per year under conservative assumptions.[32]



Third, the use of sustainable wood for heating can help mitigate climate change as it emits less GHG over the course of time, especially when compared to heating oil sources. As exposed by the Manomet Center for Conservation Sciences ("Manomet") study, when replacing oil-fired thermal and Combined Heat and Power ("CHP"), the use of woody biomass was found to offset carbon emissions in five years and provide carbon benefits after that.[33] Therefore, the use of woody biomass for energy, particularly for heating, presents a compelling case in the U.S. This is particularly true in the Northeast states since "[i]f there is to be an American Revolution in how we produce thermal energy sustainably, it should appropriately begin in the northeastern United States."[34]

Woody-To-Energy: Environmental Concerns

Despite the potential benefits, there are a number of environmental concerns related to the use of wood to generate heat or CHP. For instance, extensive debate exists over carbon dioxide ("CO2") emissions from biogenic sources, as well as concerns about other pollutants that are released into the air from burning wood, e.g. particulate matter, mercury and ozone.[35] Forests are also major carbon sinks and any increase in the harvesting numbers can negatively affect carbon storage if not properly managed. Other significant reservations regarding the use of woody biomass relate to the loss of biodiversity, soil quality degradation, and changes in land use.[36]

Pollutant Emissions

One of the biggest concerns regarding the use of woody biomass as an energy source is the release of carbon emissions. For years, the use of woody biomass was encouraged under different frameworks and guidelines because of its "renewable" characteristics and because burning wood was understood as "carbon neutral." The "carbon neutrality" of woody biomass relied on the idea of the carbon natural cycle, in which the carbon released in the atmosphere due to plant decomposition or burning is recaptured through the photosynthesis process.[37] As it is historically understood, "[t]his process results in no net gain or loss in carbon in the earth´s surface or atmosphere."[38]

Nevertheless, the concept of woody biomass as "carbon neutral" has since been reviewed. The Intergovernmental Panel on Climate Change ("IPCC") has repeatedly denied in its reports the automatic consideration of biomass as "carbon neutral" because:

> (1) in any time period there may be CO2 emissions and removals due to the harvesting and regrowth of bioenergy crops; (2) land-use changes caused by biomass production can also result in significant GHG fluxes; (3) there may also be significant additional emissions which are estimated and reported in the sectors where they occur.[39]

In the U.S., the debate intensified after the release of the "Biomass Sustainability and Carbon Policy Study," developed with the goal "to help inform the [Massachusetts] legislature as to the feasibility of substituting wood biomass for coal in some of its electrical power generation."[40] The study looked at policy questions, including the atmospheric GHG implications of shifting energy production from fossil fuels to woody biomass, and the ecological impacts of increased biomass harvest and policies needed to promote a sustainable harvest.[41] While the study found that the displacement of coal and natural gas electricity by woody biomass would only be beneficial from an emission perspective after twenty-one and ninety plus years, respectively, the study concluded that emissions benefits could be found after just five years of the displacement of oil-fired thermal and CHP by woody biomass.[42] Following those five years, woody biomass heating systems would provide carbon dividends "atmospheric greenhouse gas levels that are lower than would have occurred from the use of fossil fuels to produce the same amount of energy."[43] The same conclusion was reached by various organizations.[44]

Despite the potential benefits, woody biomass for energy can no longer be considered a "carbon neutral" source, at least in the first years of the displacement. Considering the short-term emission reduction goals, several states have in place a timeframe that can impose constraints on the use of woody biomass. The State of Massachusetts, which has an initial annual CO2 emissions budget of 26,660,204 short tons under the Regional Greenhouse Gas Initiative ("RGGI"), reviewed the definition of renewable biomass under its RPS in 2012.[45] To ensure that only wood technologies that would provide benefits to the environment and, help the state comply with short-term GHG emission reductions, were used for renewable energy certificates ("RECs"), Massachusetts now requires higher efficiency standards for qualifying biomass units.[46]

The U.S. Environmental Protection Agency ("EPA") is also reviewing its long-time policy regarding the carbon neutrality of woody biomass and aims to create a biogenic accounting framework. In 2011, the EPA decided to defer CO2 emissions accounting from bioenergy and other biogenic sources under the Clean Air Act for three years[47] in order to conduct a detailed examination of the science associated with biogenic CO2 emissions from stationary sources.[48] The EPA has not yet adopted a specific procedure to account for biogenic emissions.[49]

In addition to GHG emissions, there are other pollutant emissions that stem from the use of woody biomass for energy. For example, the use of woody biomass for energy can be responsible for the release of "particulate matter (PM), nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO^2), lead (Pb), mercury (Hg), and other hazardous air pollutants (HAPs)."[50] HAPs are of special attention, since they "are known or suspected to cause cancer and other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects."[51] The release of these pollutants is even greater when utilizing inefficient equipment, which usually leads to incomplete fuel combustion and the release of methane, a gas that is twenty times more potent than CO2.[52] As pointed out by the World Health Organization ("WHO"): "indoor air pollution – generated largely by inefficient and poorly ventilated stoves burning biomass fuels such as wood, crop waste and dung, or coal – is responsible for the deaths of an estimated 1.6 million people annually."[53] The emissions of such pollutants can be eliminated or mitigated through the adoption of technologies that promote better efficiency and combustion targets.

Carbon Storage

Another concern intrinsically related to carbon emissions is the decrease of carbon storage due to harvesting activities. Forests are a major carbon sink, meaning that carbon is stored in forests in the form of living trees, roots, or decay material in the soil.[54] In 2010, "U.S. forests and long-lived wood products accounted for a net sink of 251 million metric tons of carbon (922 million metric tons CO2)."[55] Annually, U.S. forests are

responsible for "offsetting close to [eleven] percent of total U.S. annual carbon emissions;"[56] an estimated twenty-two percent of all the carbon is currently stored on the world's land surface.[57] The Northeast's forests are estimated to store as much as 6.8 billion tons of carbon, with thirty-eight percent in the form of soil organic carbon, thirty-eight percent in aboveground biomass, ten percent as litter, six percent as dead wood, and eight percent as below ground biomass.[58]

This ecological function is especially important in a carbon-constrained world threatened by climate change. Ensuring that harvesting for woody biomass will not negatively affect the carbon storage capacity of U.S. forests is highly relevant if woody biomass is to provide a renewable and sustainable alternative to heating oil in the U.S. and the Northeastern states.

Forest Sustainability

An additional environmental concern relates to forest sustainability and how harvesting woody biomass for energy can negatively affect biodiversity, soil, water quality and productivity. There are two main concerns regarding biodiversity loss: the renewability of trees and the loss of species that depend on forests to survive. Tree renewability refers to the concept that only a finite amount of trees are available, and replacing them takes time. Thus, to be claimed a renewable source woody biomass must not be harvested at a faster rate than can naturally be replenished. However, the Natural Resources Defense Council affirms that unsustainable harvesting is happening now, as "most of the biomass we use commercially today comes from resources that are not sustainable."[59] Additionally, many species depend on forest habitats to survive. As stated by the World Wildlife Fund, "forests are home to 80% of the world's terrestrial biodiversity."[60] In Vermont, for instance, its forests are estimated "to be home to 441 species of birds, mammals, amphibians, and reptiles."[61]

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Harvesting for woody biomass can also impose a threat to soil — the foundation of ecosystems.[62] If improperly managed, harvesting activities can negatively influence soil quality and productivity, affecting the function soil provides to the forest and ecosystems. Soil's functions include, among others: serving as a habitat for numerous organisms, supporting hydrological processes, creating favorable conditions for decomposition and regeneration (including growth of trees), and storing carbon.[63] Healthy soil also improves forest resistance, resilience, and adaptation, which are important services in a world threatened by climate change.[64]

Finally, water degradation is also pointed out as a possible downside of harvesting wood for energy.[65] One of the main concerns regarding harvesting for woody biomass is water pollution during harvesting activities can impact the ecosystem and also "negatively affect the use of water for drinking, household needs, recreation, fishing, transportation, and commerce." [66]

Overcoming the Concerns

While there are several environmental concerns regarding the use of woody biomass for energy, many not easily overcome, this does not mean that its use should be discouraged.[67] Biomass pollutant emissions can be mitigated through the adoption of efficient technologies and ensuring that woody biomass is only used to displace energy fuels where carbon net benefits can be felt in the short, medium, or long-term, depending on the national and state policies. Regarding carbon storage and forest sustainability, forest management guidelines can be adopted to overcome most of the concerns related to biomass harvesting activities through the adoption of Biomass Harvesting Guidelines ("BHG"). As pointed out by the North East State Forest Association in 2012, ten states have already adopted some form of BHG addressing, among others, concerns related to soil, water quality, and biodiversity.[68] However, of those states, only California, Oregon, and Washington have provisions regarding carbon storage.[69]

If the environmental concerns are properly addressed in BHGs and woody biomass suppliers are forced to comply with the guidelines, the "utilization of woody biomass for bioenergy can help mitigate greenhouse gases, contribute to the development of healthier forests, bolster rural economies, and reduce the nation's dependency on foreign oil."[70] Secondary benefits, such as reduction in firefighting expenditures from forest-thinning projects, can also be felt if the correct policies are in place.[71]

Energy Policies Surrounding Wood-to-Energy Use

Once the initial environmental obstacles are overcome, woody biomass provides a great alternative source to the U.S.'s strong dependency on fossil fuels and an opportunity to mitigate climate change. Several energy policies, both at a federal and state level, are currently in place regarding the use of woody biomass for energy. Despite federal and state efforts, such policies are not enough to regulate the market in a way that incentivizes the increased use of biomass for energy in an environmentally friendly and sustainable way. This section briefly presents the main provisions that incentivize the use of woody biomass.

American Recovery and Reinvestment Act ("ARRA")[72]

The 2009 ARRA, also known as the stimulus package, provides appropriations to help increase economic efficiency and to

invest in environmental protection that will provide long-term economic benefits. For example, the ARRA provides $400 million for the Advanced Research Projects Agency – Energy under the America COMPETES Act.[73] The goal of the program is to enhance the economic and energy security of the U.S. through the development of energy technologies and to ensure the U.S. has a leading role in developing and deploying advanced energy technologies.[74] The ARRA also allocates funds for Wildland Fire Management, under the Department of Agriculture, for "wood-to-energy grants to promote increased utilization of biomass from Federal, State, and private lands."[75]

Internal Revenue Code ("IRC")

There are several tax incentives for renewable energy use, many of which include biomass. The Business Energy Investment Tax Credit ("ITC")[76] provides energy credits of ten percent for investments on equipment used to generate heat and electricity, also known as CHP.[77] CHP systems that use biomass are included among the eligible facilities.[78] The Clean Renewable Energy Bonds[79] provides tax credits bonds to renewable energy projects used against bondholder's federal income tax.[80] Only renewable projects, including closed-loop and open-loop biomass facilities, developed by the government or electric co-ops are eligible.[81]

The Farm Bill[82]

The Agricultural Act of 2014, also known as the Farm Bill, provides a number of energy and agricultural subsidies, including several biomass friendly programs. One example is the Forest Biomass for Energy Program, created to develop technology and techniques to use low-value forest biomass. Those techniques include forest health treatments and hazardous fuels reduction used for the production of energy. These developments integrate the production of energy from forest biomass to manufacturing streams, and improve the growth and yield of trees intended for renewable energy production.[83] Additionally, the Rural Energy for America Program[84] provides financial assistance to agricultural producers and rural small business for renewable investments.

The Farm Bill also extended the Biomass Crop Assistance Program ("BCAP"),[85] which is designed to "(1) support[s] the establishment and production of eligible crops for conversion to bioenergy in selected BCAP project areas, and (2) assist[s] agricultural and forest land owners and operators with collection, harvest, storage, and transportation of eligible material for use in a biomass conversion facility."[86] The 2014 Farm Bill amended the eligible material for the program, specifying that for woody eligible material, only those materials produced as (i) a byproduct of a preventive treatment that is removed to reduce hazardous fuel or to reduce or contain disease or insect infestation, (ii) harvested in accordance with the Healthy Forests Restoration Act of 2003 of Federal land, and (iii) delivered to a qualified biomass conversion facility to be used for heat, power, bio-based products, research, or advanced biofuels may be considered.[87] The BCAP creates two different assistance programs for owners and operators of agricultural and nonindustrial private forest land who wish to establish, produce, and deliver renewable biomass feedstocks needed by a biomass conversion facility, located within an economically practicable distance from the biomass conversion facility.[88]

Furthermore, the 2014 Farm Bill extended the Community Woody Energy Program,[89] which was created to assess available feedstocks and long-term feasibility of supplying and operating a community wood energy systems owned or operated by State or local governments that use biomass as primary fuel.[90] The eligible systems include single facility central heating, district heating, and combined heat and energy systems.[91] The program provides grants for the costs to develop community wood energy plans, plus competitive grants to acquire or upgrade the community wood energy systems, and provides grants to biomass consumer cooperatives.[92] Grants are awarded to "biomass consumer cooperatives which provide consumers with services or discounts relating to: (i) the purchase of biomass heating systems; (ii) biomass heating products, including wood chips, wood pellets, and advanced biofuels; or (iii) the delivery and storage of biomass of heating products."[93]

Energy Policy Act of 2005 ("EPAct") [94]

The programs established under the Energy Policy Act of 2005 seek to increase the efficiency of all energy intensive sectors, to promote diversity of energy supply, to decrease the dependence of the U.S. on foreign energy supplies, improve the energy security of the U.S., and decrease the environmental impact of energy-related activities.[95]

One of such programs is the Biomass Commercial Grant Program.[96] Directed to small communities with populations under 50,000 inhabitants, the Biomass Commercial Grant Program is designed for communities and other entities that own or operate a facility that uses biomass as a raw material to produce electric energy, sensible heat, transportation fuels, and others. The biomass used in such facilities is required to originate from non-merchantable materials or pre-commercial thinning that are by-products of preventive treatments.[97] The grants under this section may not exceed twenty dollars per green ton of biomass delivered.[98] Likewise, the Biomass Use Grant Program[99] provides up to $500,000 to projects that develop or research opportunities to improve the use of, or add value to, biomass.[100]

The Research and Development Energy Efficiency Program[101] provides grants to programs for research, development, demonstration, and commercial application of cost-effective technologies to improve energy efficiency and environmental performance of buildings.[102] This includes CHP units and the increased use of renewable sources for fuel.[103] Additionally, the Micro-Generation Energy Technology program allows merit-based grants for the development of micro-generation energy technology which: (i) explores "small-scale CHP in residential heating appliances, (ii) use of excess power to operate other appliances within the residence, and (iii) supply of excess generated power to the power grid."[104] There are several other grant-based programs similar those mentioned above for various areas of renewable energy use and development.

The Energy Independence & Security Act of 2007 ("EISA")[105]

EISA was enacted to "move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gases capture and storage options, and to improve energy performance of the Federal Government."[106] Two provisions are worth mentioning.

First is the Energy Efficiency and Conservation Block Grants Program, which provides grants to state and local government units to implement strategies to: "(i) reduce fossil fuel emissions through an environmentally sustainable manner which maximizes benefits to local and regional communities, (ii) reduce total energy use of the entities, and (iii) improve energy efficiency."[107] Such uses include energy distribution technologies that increase energy efficiency, like district heating systems from renewable sources such as biomass.[108] It is for these uses that an eligible entity can apply for grants under this program. Second, the Renewable Energy Construction section of the Act establishes grants to entities of up to fifty percent of the costs of renewable energy projects, including biomass projects.[109]

"With help from private investors, improvements in technology have made the use of wood as an energy source more efficient, and thus, more financially attractive."

Canada & Woody Biomass

Canada draws special attention because of its vast policies and incentives regarding the use of woody biomass.[110] Canada has demonstrated a distinct interest in biomass from woody sources, mostly due to its vast potential to provide such a resource.[111] With a forested area of 993 million acres, forty-four percent of Canada's territory is covered with forests.[112] Today, Canada's biomass industry accounts for 3.2 million tons ("MT") of pellet capacity, with another 336,000 tons under construction.[113] In 2008, woody biomass thermal production generated 31,277 gigawatts/hour ("GWh").[114] Additionally, sixteen community heat plants have been built in the last two years, twelve more are currently under construction, and twenty-six are in the planning stages.[115] The Canadian Institute of Forestry pointed out the sustainability of using Canadian forests for these purposes, affirming:

> Canadian interdisciplinary forestry, which includes excluding operations from areas of high conservation and cultural value and modifying operations in other areas, ensures that biodiversity, wildlife habitat, water quality, soils and cultural values are all well integrated and proactively and effectively managed in policy, planning and practice, without exception.[116]

Despite the criticism regarding the use of wood sources for producing electricity because of the "long carbon payback time due to the slow regrowth of forests and the fragility of existing carbon stocks,"[117] many have applauded the use of wood for heating in Canada. Greenpeace, who advocates against use of Canadian forests to provide electricity, recognizes the benefits of small–scale projects, in particular the use of mill waste and residue to be used in small-scale heating systems.[118]

To spur the deployment of such energy source, Canada has developed strong laws and policy regarding the use of woody biomass over the years. Canada adopted, for example, the Renewable & Conservation Expense ("CRCE") — a tax deduction directed to renewable sources for energy production.[119] Designed to put the renewable energy sector on equal footing with the non-renewable resource sector, CRCE allows the expenses of renewable energy technology to be fully deducted,[120] including CHP facilities and district heating.

Additionally, Canadian Provinces have played a large part in creating woody biomass policy. British Columbia, for instance, considers the forestry sector to be key for the Province's fight against climate change. Thus, several initiatives are in place with two different, but complementary, purposes: energy generation and sustainable forest management. Energy generation is primarily addressed by British Colombia's Bioenergy Strategy, which encourages research and development in the areas of wood-waste cogeneration, biofuel production, and wood pellet production, to name a few.[121] Sustainable forest management practices, on the other hand, are addressed by programs through British Columbia's Climate Action Plan,[122] such as Forests for Tomorrow, which is designed to enhance management practices;[123] Accelerating Forest Growth, designed "to increase growth in B.C.'s forests and reduce losses due to forest health problems;"[124] and Net–Zero Deforestation, which offsets forest land permanently removed through the plantation of trees in elsewhere.[125]

New Brunswick has also made aggressive efforts to improve the use of wood based biomass resources, focusing instead on improving the pellet industry. With more than twenty percent of the homes in this Canadian province already using wood for heating, the government's goal is to increase this percentage through the promotion of pellets and wood waste.[126] As stated in its Energy Action Plan, the goal is to develop and implement supporting policies to optimize the energy output for the province's wood based biomass resources with a specific focus on pellets.[127] With no standards currently in place for pellets in the

country, New Brunswick is gathering efforts to become the first Canadian province to provide standards for the pellet industry.[128]

Private initiatives have also played a key role in developing the woody biomass industry over the years. With help from private investors, improvements in technology have made the use of wood as an energy source more efficient, and thus, more financially attractive. One example is the first North American renewable waste wood CHP system, located at the University of British Columbia.[129] This highly efficient system is expected to produce two megawatt ("MW") of electricity and generate three MW of thermal energy, reducing annual GHG emissions by 5,000 tons per year at most.[130] Another example is the wood–fired district heating system in Charlottetown,[131] a stand–alone oil–fired boiler converted into a biomass-fired district heating system, which generates 35MW of heat and 1.2 MW of electricity.[132] This CHP plant provides eighty-five percent of Charlottetown's energy output comes from wood and municipal waste,[133] enough to provide heat to large buildings, provincial government offices, hospital, universities, shopping malls, and commercial and apartment buildings.[134]

Woody Biomass for Heating: The case for federal and state intervention

Because of the U.S.'s high dependency on fossil fuels there is an urgent need for federal and state governments to adopt policies and mandatory standards to address heating concerns and incentivize the use of sustainable woody biomass for heating, which would provide cleaner energy than oil. As previously noted, it is clear that there is not enough legislation currently in place that addresses heating. This section will present a number of recommendations to be adopted by both governmental levels.

Federal Recommendations

Two major steps must be taken at the federal level. The first is the recognition that the heating sector should be included among the energy sectors targeted when addressing climate change concerns. This recognition would help lay the foundations for a national policy to support renewable thermal energy. One means of support is to expressly include heating among the actions presented in the 2014 Climate Action Plan.

Another example would be the adoption of a thermal renewable roadmap in a similar fashion to Maine's Act Regarding the state's Energy Future (LD 1485). Maine's Act establishes twenty percent savings from heating fossil fuels by 2020, and a ten percent reduction below 1990 levels of GHG emissions from heating of buildings. Following this rationale, the federal government should establish specific targets to be met by the heating sector by 2020, 2030, and 2050 (short, medium, and long–term). The targets shall be established with the goal of reducing reliance on fossil fuels, increasing the use of renewable energy, and decreasing GHG emissions from the heating sector.

A second step is to develop both mandatory standards to implement the heating policy and specific targets established in the national thermal policy or roadmap. This could be done through the adoption of a national Renewable Thermal Standard ("RTS"), which would establish a specific amount of renewable energy fuel to be blended into heating oil, following Massachusetts' example. During the winter of 2007 and 2008, Massachusetts Office of Energy and Environmental Affairs launched a pilot program where a few state facilities use bioheat fuel derived from vegetable oils and animal fats.[135] Despite delivery issues, all participants in the program were willing to continue using the blended fuel as well as recommend it to others. As a result, Massachusetts passed a two percent mandate blend of biofuel with heating oil by 2010, and five percent by 2013.[136] Following the same direction, the City of New York adopted a mandatory two percent biodiesel in all commercial and residential heating oil used in 2012.[137]

Moreover, the U.S. government could expand federal incentives to thermal applications through the inclusion of woody biomass sources in several renewable energy provisions. While there are a number of provisions in the IRC, which include woody biomass among the eligible energy sources for tax incentives, several other energy sources like solar and fuel cells are not included for tax incentives. However, these other sources could easily be included. The first example is the Residential Energy Efficiency Property Credit,[138] which provides a tax credit of thirty percent for qualified solar electric, solar water, fuel cell, small wind, or geothermal expenditures generated by a taxpayer during the tax year. Notably, biomass expenditures are not eligible for this credit, however, this section could easily be amended to allow credits from eligible woody biomass expenditures, such as specific stoves and fireplaces.

Another example refers to the Renewable Energy Production Tax Credit ("PTC"),[139] which provides tax credits for businesses that use renewable sources for electricity production.[140] Even though closed-loop biomass"[141] and open-loop biomass[142] facilities are among the eligible sources, the PTC should be extended to thermal production in order to allow heating systems to qualify for the tax credits. The Energy Efficient Commercial Buildings Deduction,[143] which provides a deduction for commercial building's property investment in energy efficiency, could also incorporate biomass technologies, in order to incentivize the replacement of less efficient technologies that produce several of the pollutant problems previously highlighted.

The 2005 EPAct should also be amended to broadly include woody biomass technologies under its renewable programs. For instance, the Energy Efficiency Appliance Rebate Program[144] is offered to states that have adopted an energy efficient appliance rebate program to provide rebates to residential consumers who purchase residential energy efficient products, such as Energy Star. The program, however, does not include wood burning stoves. Despite their current lack of inclusion, energy efficient and pollutant controlling stoves could and should be included in such programs. Additionally, the Energy Efficient Public Buildings Program[145] provides grants to local governments that improve the energy efficiency of public buildings and facilities by at least thirty percent of the cost of the investment. This program is another opportunity for the law to be expanded to include biomass heat or CHP facilities.

Over the years, proposed bills have presented other suggestions. Examples of these bills include the Thermal Energy Efficiency Act (Senate 1621); the American Renewable Biomass Heating Act (House of Representatives 2080); the Cleaner, Securer, Affordable Thermal Energy Act (Senate 1643); the Renewable Production Act (Senate 1094); and Thermal Renewable and Efficiency Act (House of Representatives 5805). Some of the proposed provisions in these bills included:

- Thermal Energy Efficiency Fund to provide grants for qualifying district energy, CHP, or recoverable waste energy projects;
- Thirty percent energy tax credit for investment in biomass heating property under the IRC;
- Bonus depreciation of property used to convert a home heating system;
- Tax-exempt energy conservation bond to finance conversions of fuel oil heating systems; and
- Tax credit for the production of non-electric energy from renewable resources.

Regional Recommendations

Several approaches are possible for adoption at the state level in order to spur the development of woody biomass for heating. Using the Northeast region as an example demonstrates one approach to extend the RGGI to thermal generating units. RGGI is a cooperative effort between nine Northeastern and Mid-Atlantic States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to reduce GHG emissions in the region.[146] In order to combat climate change, RGGI establishes a CO2 Budget Trading Program in an effort to reduce carbon emissions from "fossil fuel–fired electricity generating units having a rated capacity equal to or greater than twenty-five megawatts."[147] Plants that fall under the RGGI scheme may get allowances from any state participating in RGGI and may use those allowances to show compliance with an individual state's program.[148] By amending Article 1 of RGGI's Memorandum of Understanding to include fossil-fuel thermal providers in the initiative, RGGI would create a mandate for heating oil suppliers to reduce its carbon footprint, and incentivize the use of cleaner heating sources, including sustainable, efficient woody biomass.

A second approach would be to include heating energy output from renewable energy sources as eligible sources for the generation of RECs under states' RPS. RECs are tradable commodities that "authenticate that 1MWh of electricity was generated from qualifying renewable resource,"[149] and serve as a compliance mechanism to ensure that RPS goals are met by the electric suppliers. While the electric output of woody biomass sources are qualified as a qualifying renewable resource under all of the RPS programs in the U.S., the thermal output has traditionally been excluded from the REC's eligibility. However, since 2013, New Hampshire includes useful thermal energy under its RPS program. [150] As stated in Section § 362-F:2 (XV-a), "renewable energy delivered from Class I sources that can be metered… in the form of direct heat, steam, hot water, or other thermal form that is used for heating, cooling, humidity control, process use, or other valid thermal end use energy requirements and for which fuel or electricity would otherwise be consumed,"[151] are able to generate RECs.

Under New Hampshire's RPS framework each 3,412,000 BTUs of useful thermal energy is equivalent to one MWh of electricity, and, consequently, to one REC.[152] Additional requirements related to woody biomass sources should be imposed in order to address system efficiency, pollutant emissions, and forest sustainability. Requirements for thermal energy under RPS should include: (i) definition of eligible wood sources permissible to use for the qualifying facility; (ii) emission requirements, in particular nitrogen oxide (NOx) and particulate matter (PM) emissions; (iii) minimum efficiency levels; and (iv) adoption of BHG. The inclusion of woody biomass heating as eligible renewable sources capable of generating RECs would create an additional incentive to thermal providers, helping spur the deployment of renewable thermal technologies.

"As a valuable renewable energy resource, woody biomass can once again play a key role in providing primary heating source to many homes in the U.S."

State Recommendations

Finally, another approach would be to extend several individual states' successful initiatives to a regional or federal level. Examples of states heating regulation include California's Bioenergy Action Plans, Vermont's Fuels for Schools and Use Value Appraisal programs, and Maine's Wood-to-Energy Task Force.

California's Bioenergy Action Plans were developed pursuant to Executive Order S-06-06[153] to meet the target of generating twenty percent of the state's renewable energy from biopower[154] by 2010 and maintaining this percentage through 2020.[155] The Plans spurred biomass energy deployment, in particular for CHP for schools, hospitals, and industry.[156] California generates the 36 million tons of biomass it uses in state from the urban, agriculture and forest sectors.[157]

Vermont's Fuels for Schools ("VFFS") is a "renewable energy-use initiative to promote and encourage the use of a renewable, local natural resource to provide reliable heat for Vermont schools."[158] The goal of the program is to use "woodchip and other biomass heating systems that replace expensive fossil fuels with locally produced wood fuels." [159] As stated by the Biomass Resource Energy Center, wood was the primary heating fuel for roughly twenty percent of the Vermont public school students.[160] The success of the program incentivized the U.S. Forest Service to adopt a similar program nationwide. However, the program is focused on western states, and does not include governmental buildings and hospitals.

Another example from Vermont is the Use Value Appraisal program, which "enables landowners who practice long–term forest management to have their enrolled land appraised for property taxes based on its value for forestry, rather than its fair market (development) value."[161] The adoption of such a program in other states or on the federal level would incentivize landowners attracted to harvested wood for energy to continue to follow forest management practices.

Recently Maine developed a Wood–to–Energy Task Force to investigate and recommend strategies for using the forest resources in Maine and to help relieve Maine citizens of the cost and dependence on "traditional energy" sources.[162] The Task Force looks at conservation and sustainable management of forests, air pollution created by wood burning stoves, public safety, water quality issues, and protection of wildlife.[163] The Task Force also considered other renewable energy sources, like wind and tidal, when making its recommendations regarding the use of woody biomass.[164]

Conclusion

There is an imminent need for heating to be included in climate change policies. Accounting for one-third of all the energy consumed in the U.S., heating is a major GHG emissions source, especially when considering the fossil fuel dependency for heating homes in the Northeastern states. As a valuable renewable energy resource, woody biomass can once again play a key role in providing primary heating source to many homes in the U.S. Despite the existence of several environmental concerns related to its use, the adoption of proper BHG can not only help mitigate these concerns, but can increase the resilience of forests to climate change impacts.

While countries, like Canada, have already realized the benefits of using woody biomass for heating, the U.S. seems to have left this source behind. The legislation currently in place does not properly incentivize renewable heating sources. However, the federal government and state governments are in a position to adopt several actions to fix this disparity when applied to transportation and electricity production. For instance, on the federal level, the inclusion of heating among the targeted sectors in climate change policy would be a needed first step to support the deployment of renewable thermal energy. The establishment of thermal GHG emission reduction goals, in addition to Renewable Thermal Standard, should also be adopted.

Financial incentive expansions are imperative to implementing renewable woody biomass for providing thermal energy. The expansion and adoption of additional provisions in the Internal Revenue Code and 2005 EPAct to include woody biomass among the eligible energy sources for tax incentives are necessary if we want to reap the benefits of renewable transportation and electricity sources to renewable heating sources. Examples include the Residential Energy Efficiency Property Credit, Renewable Energy Production Tax Credit (PTC), and the Energy Efficiency Appliance Rebate Program.

Viewing the Northeastern states as a regional example, RGGI could be extended to include fossil–fuel thermal providers in the initiative, creating a mandate for them to reduce their carbon footprint through the adoption of renewable heating sources. A second approach would be the inclusion of thermal energy output from renewable energy sources among the eligible sources for the generation of RECs for compliance with RPS programs.

Finally, several states initiative addressing thermal energy could be easily adopted by other states and even by the federal government. Successful initiatives such as California's Bioenergy Action Plans, Vermont's Fuels for Schools and Use Value Appraisal programs, and Maine's Wood-to-Energy Task Force, could be useful tools to help spur the development of renewable heating energy, mitigate climate change, and reduce U.S. fossil fuel dependency. The failure to take the proper steps to invest now in "renewable thermal energy would come at an enormous cost: to our citizens, our environment, our economy and our nation's security."[165]

Endnotes: Light My Fire: The Use & Policies of Woody Biomass as a Heat Source

1 *Heating the Northeast with Renewable Biomass A Vision for 2025*, Biomass Thermal Energy Council 4 (Apr. 28, 2010), *available at* http://www.biomassthermal.org/resource/pdfs/heatne_vision_full.pdf.

2 Energy Independence & Security Act of 2007, Pub. L. No. 110-140, § 202, 121 Stat. 1521 (2007) (codified as amended at 42 U.S.C. 7545(o)(2) (2007)) (amending the Clean Air Act to have a goal of 36 billion gallons by 2022).

3 Benjamin K. Sovacool & Christopher Cooper, *State Efforts to Promote Renewable Energy: Tripping the Horse with the Cart?*, 8 Sustainable Dev. L. & Pol., 1, 6 (2007).

4 U.S. Energy Info. Admin., *Most states have Renewable Portfolio Standards*, Today in Energy (Feb. 3, 2012) http://www.eia.gov/todayinenergy/detail.cfm?id=4850.

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[5] Arne Jungjohann, *Foreword* to The Missing Piece in Climate Policy: Renewable Heating and Cooling in Germany and the U.S., at iv (Heinrich Boll Foundation) (2008), *available at* http://us.boell.org/sites/default/files/downloads/The_Missing_Piece_in_Climate_Policy.pdf.

[6] *See*, e.g., *Implementing Agreement on District Heating and Cooling, Including the Integration of Combined Heat and Power*, INT'L ENERGY AGENCY, http://www.iea-dhc.org/the-programme/background.html (last visited Dec. 22, 2014) (discussing how efficient heating and cooling, particularly CHP, can significantly reduce energy use and GHG emissions because regular heating uses a lot of energy).

[7] *Heating the Northeast with Renewable Biomass A Vision for 2025*, *supra* note 1, at 4.

[8] *Id*. at 3.

[9] U.S. Energy Info. Admin., *Heating and Cooling No Longer Majority of U.S. Home Energy Use*, TODAY IN ENERGY (Mar. 17, 2013) http://www.eia.gov/todayinenergy/detail.cfm?id=10271.

[10] U.S. Energy Info. Admin., *Household heating fuels vary across the country*, TODAY IN ENERGY (Oct. 28, 2011) http://www.eia.gov/todayinenergy/detail.cfm?id=3690.

[11] U.S. Energy Info. Admin., *Short-Term Energy and Winter Fuels Outlook*, TODAY IN ENERGY Table WF01 (Oct. 2013) http://www.eia.gov/forecasts/steo/archives/oct13.pdf

[12] U.S. Dep't of Energy, *Heating Oil Reserve*, OFFICE OF FOSSIL ENERGY http://energy.gov/fe/services/petroleum-reserves/heating-oil-reserve (last visited Dec. 22, 2014).

[13] U.S. Energy Info. Admin., *U.S. Households Forecast to use More Heating Fuels this Winter Compared with Last Winter*, TODAY IN ENERGY (Oct. 10, 2012) http://www.eia.gov/todayinenergy/detail.cfm?id=8310.

[14] ANTHONY ANDREWS, *The Northeast Home Heating Oil Reserve and the National Oil Heat Research Alliance*, CONG. RESEARCH SERV. 5-6 (Sept. 19, 2013), *available at* http://www.hsdl.org/?view&did=745275.

[15] *Id.*

[16] U.S. ENERGY INFO. ADMIN., NORTHEASTERN WINTER NATURAL GAS AND ELECTRICITY ISSUES (Jan. 7, 2014), *available at* http://www.eia.gov/special/alert/east_coast/pdf/energy_market_alert_Jan_7_2014.pdf.

[17] *Vermont Yankee Nuclear Power Plant*, ENTERGY, http://www.entergy-nuclear.com/plant_information/vermont_yankee.aspx (last visited Dec. 22, 2014).

[18] ANDREWS, *supra* note 14, at 3-4 (from 2000 to 2012, the price of propane gallon jumped from $1.00 to $2.80).

[19] U.S. Energy Info. Admin., *Heating Fuel Expenditures Rise this Winter, Especially for Propane-Heated Homes*, TODAY IN ENERGY (Mar. 12, 2014) http://www.eia.gov/todayinenergy/detail.cfm?id=15371.

[20] U.S. Energy Info. Admin., *Energy Sources Have Changed Throughout the History of the U.S.*, TODAY IN ENERGY (July 3, 2013) http://www.eia.gov/todayinenergy/detail.cfm?id=11951.

[21] *Biomass Fact Sheet*, HARVARD GREEN CAMPUS INITIATIVE 1 (2013), *available at* http://www.learningace.com/doc/479724/af2dc106d06ed9acbbb465dd1a92fdc8/biomass-fact-sheet.

[22] The Northeast states are Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania.

[23] U.S. Energy Info. Admin., *10.1 Renewable Energy Production and Consumption by Source*, MONTHLY ENERGY REVIEW (OCT. 2014), *available at* http://www.eia.gov/totalenergy/data/monthly/pdf/sec10_3.pdf.

[24] U.S. Energy Info Admin., *Energy Perspectives 1949–2011*, TOTAL ENERGY (Sept. 27, 2012), *available at* http://www.eia.gov/totalenergy/data/annual/perspectives.cfm.

[25] U.S. ENERGY INFO. ADMIN., SHORT-TERM ENERGY AND WINTER FUELS OUTLOOK 4 (Oct. 2014), *available at* http://www.eia.gov/forecasts/steo/archives/Oct14.pdf (referencing the "projected winter fuel expenditures by fuel and region" of the report).

[26] Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

[27] *See* U.S. ENERGY INFO. ADMIN., *supra* note 25, at 4.

[28] 2014 CAR: UNITED STATES CLIMATE ACTION REPORT (2014), *available at* http://www.state.gov/documents/organization/219038.pdf.

[29] *Id.* at 2.

[30] DR FOSTER ET AL., WILDLAND & WOODLANDS: A FOREST VISION FOR THE NEW ENGLAND LANDSCAPE 4 (2010), *available at* http://silviculture.forestry.umn.edu/prod/groups/cfans/@pub/@cfans/@forestry/documents/asset/cfans_asset_241283.pdf.

[31] *Id.* at 4.

[32] *Heating the Northeast with Renewable Biomass A Vision for 2025*, *supra* note 1 at 14.

[33] THOMAS WALKER ET AL., MANOMET CTR. FOR CONSERVATION SCIS, BIOMASS SUSTAINABILITY AND CARBON POLICY STUDY 7 (June 2010), *available at* https://www.manomet.org/publications-tools/sustainable-economies/biomass-sustainability-and-carbon-policy-study-full-report.

[34] *Heating the Northeast with Renewable Biomass A Vision for 2025*, *supra* note 1, at 4.

[35] *Air pollution from biomass energy*, P'SHIP FOR POLICY INTEGRITY, (Mar. 17, 2011) http://www.pfpi.net/air-pollution-2.

[36] *See*, *e.g.*, *Criteria & Indicators for Forest Sustainability*, U.S. DEP'T OF AGRIC. FOREST SERV., http://www.fs.fed.us/research/sustain/criteria-indicators/ (last visited Dec. 22, 2014) (demonstrating that those criteria cover the many concerns regarding harvesting woody biomass for energy, which can be more aggressive than harvesting for different purposes, and which are often broken down into four major categories: water resources, soil, biodiversity/wildlife, carbon emission and storage).

[37] Evan N. Turgeon, *Federal Forests, Biomass, and Ethanol: Energy Security Sabotaged*, 39 ENVTL. L. REP. 10140, 10146 (2009).

[38] *Id.* at 10146. In contrast to oil, which "also contains carbon, but carbon that was sequestered millions of years ago. Pumping oil to the surface of the earth and burning it results in an increase in the amount of carbon on the earth´s surface. Since plants absorb a constant amount of CO2, most of the CO^2 released from burning oil stays in the earth´s atmosphere, contributing to global warming").

[39] *IPCC Task Force on National Greenhouse Gas Inventories (TFI), general guidance and other inventory issues*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, http://www.ipcc-nggip.iges.or.jp/faq/faq.html (last visited Dec. 22, 2013).

[40] ROGER A. SEDJO, COMPARATIVE LIFE CYCLE ASSESSMENTS: CARBON NEUTRALITY AND WOOD BIOMASS ENERGY 7 (Apr. 2013), *available at* http://www.rff.org/RFF/Documents/RFF-DP-13-11.pdf.

[41] THOMAS WALKER ET AL., *supra* note 33, at 6.

[42] *Id.* at 7.

[43] *Id.* at 6.

[44] *See*, e.g., *Issue Brief: Biomass Carbon Neutrality*, WORLD BUS. COUNCIL FOR SUSTAINABLE DEV. (Jan. 2013), *available at* http://www.wbcsd.org/Pages/EDocument/EDocumentDetails.aspx?ID=15347&NoSearchContextKey=true (last visited Dec. 22, 2014) (pointing out several factors needing consideration when analyzing the carbon neutrality of woody biomass: (i) physical boundaries (direct and indirect impacts on the atmosphere), (ii) organizational boundaries (life cycle), (iii) spatial boundaries (on-site and off-site), and (iv) temporal boundaries (neutrality varies depending on the time frame analyzed).

[45] *See Renewable Portfolio Standard – Biomass Policy Regulatory Process*, MA. EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS, http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/biomass/renewable-portfolio-standard-biomass-policy.html (last visited Dec. 29, 2014) (referencing the attached proposed and final regulatory documents).

[46] *Id.*

[47] Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31514 (June 3, 2010) (to be codified at 40 C.F.R. pts. 51, 52, 70 &71), *available at* http://www.gpo.gov/fdsys/pkg/FR-2010-06-03/pdf/2010-11974.pdf.

[48] *Id*. at 31590-91.

[49] *Carbon Dioxide Emissions Associated with Bioenergy and Other Biogenic Sources*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/climatechange/ghgemissions/biogenic-emissions.html (last visited Dec. 22, 2014).

[50] *Air pollution from biomass energy*, *supra* note 35.

[51] *About Air Toxics*, U.S. ENVTL. PROT. AGNECY, http://www.epa.gov/ttn/atw/allabout.html (last visited Dec. 29, 2014).

[52] *Overview of Greenhouse Gases: Methane Emissions*, U.S. ENVTL. PROT. AGNECY, http://epa.gov/climatechange/ghgemissions/gases/ch4.html (last visited Dec. 22, 2014).

[53] Health and Env't Linkages Initiative, *Indoor Air Pollution and Household Energy*, World Health Org., http://www.who.int/heli/risks/indoorair/indoorair/en/ (last visited Dec. 22, 2014).

[54] Vt. Monitoring Cooperative, Vermont's Changing Forests: Key Findings on the Health of Forested Ecosystems from the Vermont Monitoring Cooperative 10 (Oct. 2009), *available at* http://www.uvm.edu/rsenr/wkeeton/pubpdfs/SleeperetalVMCForestHealthSynthesisReport.pdf.

[55] *Forests and Carbon Storage*, U.S. Dep't of Agric. Forest Serv., http://www.fs.usda.gov/ccrc/topics/forest-carbon (last visited Dec. 22, 2014).

[56] U.S. Dep't of Agric. Forest Serv., National Report on Sustainable Forests–2010 II-8 (June 2011), *available at* http://www.fs.fed.us/research/sustain/docs/national-reports/2010/2010-sustainability-report.pdf.

[57] *Id.*

[58] Robert T. Perschel Et Al., Forest Guild, Climate Change, Carbon, and the Forests of the Northeast 11 (Dec. 2007), *available at* http://www.forestguild.org/publications/research/2007/ForestGuild_climate_carbon_forests.pdf.

[59] *Biomass Energy and Cellulosic Ethanol*, Natural Res. Def. Council, http://www.nrdc.org/energy/renewables/biomass.asp, (last visited Dec. 22, 2014).

[60] *Habitats: Forests*, World Wildlife Fund, http://www.worldwildlife.org/habitats/forests (last visited Dec. 22, 2014).

[61] Vt. Monitoring Cooperative, *supra* note 54, at 9.

[62] U.S. Dep't of Agric. Forest Serv., *supra* note 56, at II-51.

[63] Considerations and Recommendations for Retaining Woody Biomass on Timber Harvest Sites in Maine 19 (J.G. Benjamin ed., Jan. 2010), *available at* http://www.maine.gov/dacf/mfs/archive/pubs/biomass_retention/report/biomass_report_lr.pdf.

[64] Robert T. Perschel et al., *supra* note 58, at 22.

[65] *See* Evan N. Turgeon , *supra* note 37, at 10448..

[66] *Water Resources*, U.S. Envtl. Prot. Agency, http://www2.epa.gov/learn-issues/water-resources (last visited Dec. 22, 2014).

[67] *EarthTalk: Biomass: Hardly Carbon-Neutral*, Az. Daily Sun (Jan. 23, 2012), http://azdailysun.com/news/science/earthtalk-biomass-hardly-carbon-neutral/article_7111cb33-c27f-5e95-a5a7-133fc8b123db.html (stating, as recognized by the Natural Resources Defense Council, "there is still a place for biomass in the alternative energy universe but cautions that only biomass that is carefully chosen, grown responsibility and efficiently converted into energy can reduce carbon and other emissions compared to fossil fuels").

[68] North East State Foresters Association, A Review of Biomass Harvesting Best Management Practices Guidelines 9 (2012), *available at* http://www.nefainfo.org/NEFA%20Biomass%20BMP%20comparison%20Report%20FINAL%209.2012.pdf.

[69] *Id*.

[70] C.D. Foster, J. Gan & C. Mayfield, *Advantages of Woody Biomass Utilization*, in Sustainable Forestry for Bioenergy & Bio-based Products: Trainers Curriculum Notebook 31, 31 (W. Hubbard, L. Biles, C. Mayfield 7 S. Ashton eds., 2007), *available at* http://www.forestbioenergy.net/training-materials/fact-sheets/module-1-fact-sheets/fact-sheet-1-3-advantages-of-woody-biomass-utilization/.

[71] *See* Evan N. Turgeon, *supra* note 37, at 10448.

[72] American Recovery & Reinvestment Act of 2009, Pub. L. No. 111-5, 123 Stat. 115 (2009).

[73] America Competes Act, Pub. L. No. 110-69, § 5012, 121 Stat. 572, 621 (2007) (codified as amended at 42 U.S.C. § 16538 (c) (2011)). This could include advancing technology in the biomass industry, especially heating & cooling and CHP facilities.

[74] *Id*. § 5012 (c)(1)(A)-(B).

[75] American Recovery & Reinvestment Act of 2009, Pub. L. No. 111-5, § 509, 123 Stat. 115, 170-71 (2009).

[76] 26 U.S.C. § 48 (2013).

[77] *Id*. § 48 (a)(1), (2)(A)(ii), (3)(A)(i), (c)(3)(A) (defining CHP, or "combined heat and power system property," as property comprising a system: "(i) which uses the same energy source for the simultaneous or sequential generation of electrical power, mechanical shaft power, or both, in combination with the generation of steam or other forms of useful thermal energy (including heating and cooling applications), (ii) which produces: (I) at least 20 percent of its total useful energy in the form of thermal energy which is not used to produce electrical or mechanical power (or combination thereof), and (II) at least 20 percent of its total useful energy in the form of electrical or mechanical power (or combination thereof), (iii) the energy efficiency percentage of which exceeds 60 percent, and (iv) which is placed in service before January 1, 2017").

[78] *Id.* § 48 (c)(3)(D).

[79] *Id.* § 54 (d).

[80] *Id. § 54 (a)*.

[81] 26 U.S.C §§ 45(c)(1)(B)-(C), 54D(d)(1) (2013) (showing that while biomass heating and CHP facilities are not directly addressed here, they could easily be).

[82] Agricultural Act of 2014, Pub. L. No. 113-79, § 1, 128 Stat. 649 (2014).

[83] 7 U.S.C. § 8112 (a), (c)(1)-(4) (2012).

[84] Food, Conservation, and Energy Act of 2008 Pub. L. No. 110-246, § 9007, 122 Stat. 2077 (a) (2008).

[85] Agricultural Act of 2014, Pub. L. No. 113-79, § 9010, 128 Stat. 932 (2014).

[86] *Id.* § 9011 (b)(1)-(2), 128 Stat. at 934 (codified as amended at 7 U.S.C. § 8111(b) (2014)).

[87] Agriculture Act of 2014, Pub. L. No. 113-79, § 9010, 128 Stat. 649, 933 (2014) (codified as amended at 7 U.S.C. § 8111(a)(6) (2014)).

[88] *Id.* § 9011 (a)(1)-(2), (5)(A)(i), (b)(2), 128 Stat. at 932, 934 (2014) (codified as amended at 7 U.S.C. § 8111(a)(2)(B) & (C) (2014)).

[89] *Id.* § 9012, 128 Stat.at 938 (2014) (codified as amended at 7 U.S.C. § 8113(a) (2014)).

[90] Agricultural Act of 2014, 7 U.S.C. § 8113 (a)(2)(A) (2012).

[91] *Id*. § 8113(a)(2)(B).

[92] *Id.* § 8113 (b)(1), (3)(C).

[93] Agriculture Act of 2014, Pub. L. No. 113-79, § 9012, 128 Stat. 649, 938 (2014).

[94] Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594 (2005).

[95] *See*, *e.g.*, Energy Policy Act of 2005, Pub. L. No. 109-58, § 802, 119 Stat. 884 (2005) (codified as amended at 42 U.S.C. § 16181(a) (2005)); Energy Policy Act of 2005, Pub. L. No. 109-58, § 931, 119 Stat. 594 (2005) (codified as amended at 42 U.S.C. § 16231(a)(1) (2005)).

[96] Energy Policy Act of 2005, Pub. L. No. 109-58, § 210, 119 Stat. 594 (2005) (codified as amended at 42 U.S.C. § 15855(b) (2005)).

[97] *Id.* § 15855 (a)(1) (2005).

[98] *Id.* § 15855 (b)(2).

[99] *Id.* § 15855 (c).

[100] *Id.* § 15855 (c).

[101] Energy Policy Act of 2005, Pub. L. No. 109-58, § 911, 119 Stat. 857 (2005) (codified as amended at 42 U.S.C. § 16191(a)(2) (2005)).

[102] 42 U.S.C. § 16191 (a)(2)(A)-(D).

[103] *Id.* § 16191 (a)(2).

[104] Energy Policy Act of 2005, Pub. L. No. 109-58, § 923, 119 Stat. 594, 865 (2005) (codified as amended at 42 U.S.C. § 16213 (2005)).

[105] Energy Independence & Security Act of 2007, Pub. L. No. 110-140, 121 Stat. 1492 (2007)

[106] *Id.* at 1668.

[107] *Id.* at § 542, 121 Stat. 1492, 1668 (2007) (codified as amended at 41 U.S.C. 17152(b) (2007)).

[108] *Id.* at § 544(9), 121 Stat. 1492, 1670 (2007) (codified as amended at 41 U.S.C. 17154(9) (2007)).

[109] *Id.* at § 803(b)(4), 121 Stat. 1492, 1720 (2007) (codified as amended at 41 U.S.C. 17282(a)(4)(ii) & (b) (2007)).

[110] Natural Res. Can.–Canadian Forest Serv., National Report to the Ninth Session of the United Nations Forum on Forests 1, 2 (Nov. 2010), *available at* http://www.un.org/esa/forests/pdf/national_reports/unff9/Canada.pdf.

[111] *See id.* at 2 (stating that Canada accounts for about ten-percent of the world´s forests).

[112] Samuel W. Jackson et al., Wood2Energy: A State of the Science and Technology Report 1, 12 (Samuel W. Jackson ed. 2010) [hereinafter Wood-2Energy], *available at* http://www.wood2energy.org/NR/rdonlyres/FA90AD38-B984-486A-B1F8-25EE8A0C5345/2623/Wood2EnergyPublication_Final_S.pdf (explaining that ninety-three percent of the forests are publicly owned; seventy-seven percent of which is owned by provincial governments and sixteen percent of which is owned by the federal government).

[113] Douglas Bradley, Canadian Bioenergy Association, Economic Impact of Bioenergy in Canada – 2011 6 (2012), *available at* http://www.canbio.ca/upload/documents/canbio-bioenergy-data-study-2011-jan-31a-2012.pdf (representing a fifty-five percent growth, or over 1 million tones, in pellet capacity from 2010 to 2011).

[114] Samuel W. Jackson et al., *supra* note 113, at 8-11.

[115] Douglas Bradley, *supra* note 114, at 3.

[116] Canadian Inst. of Forestry, *Canadian Institute of Forestry Responds to Boreal Forest Report*, The Algoma News (July 26, 2013), http://www.thealgomanews.ca/news/regional/canadian-institute-of-forestry-responds-to-boreal-forest-report/.

[117] Greenpeace, Fuelling a BioMass Why Burning Trees for Energy Will Harm People, the Climate and Forests 1, 3 (2011) *available at* http://www.greenpeace.org/canada/Global/canada/report/2011/10/ForestBiomess_Eng.pdf.

[118] *Id.* at 3-4.

[119] Income Tax Act, R.S.C. 1985, c. 1, § 66.1.

[120] *Tax Savings for Industry*, Nat. Res. Can., http://oee.nrcan.gc.ca/industrial/financial-assistance/1965 (last visited Aug. 22, 2014).

[121] British Columbia Ministry of Energy, Mines, & Petroleum Resources, BC Bioenergy Strategy: Growing Our Natural Energy Advantage 1, 8 (2008), *available at* http://www.energyplan.gov.bc.ca/bioenergy/PDF/BioEnergy_Plan_005_0130_web0000.pdf.

[122] British Columbia Ministry of Env't, Climate Act Plan 1 (2010), *available at* http://www.gov.bc.ca/premier/attachments/climate_action_plan.pdf.

[123] *Id*. at 4.

[124] *Id*. at 53.

[125] *Id*. at 4, 53-54.

[126] N.B. Dep't of Energy, N.B. Energy Blueprint 23 (2011), *available at* http://www2.gnb.ca/content/dam/gnb/Departments/en/pdf/Publications/201110NBEnergyBlueprint.pdf.

[127] *See id.*

[128] *Id.* The pellet standards shall address: (i) efficiency, emission and quality standards for central heating system, (ii) assurance and compliance program, (iii) protocols for handling, transportation and storage of pellets, (iv) expand use of wood biomass as heating source, (v) certification requirements for pellets system installers, (vi) minimal certification levels, quality assurance and sustainable forest practices for feedstock, (vii) incentives programs for biomass combine heat and power, and (viii) biomass district heating applications, among others.

[129] *Nexterra, UBC and GE Celebrate the Opening of Groundbreaking Renewable Biomass CHP–A First in N. Am.*, Nexterra (Sept. 13, 2012), http://www.nexterra.ca/files/pdf/20120913-UBC-Opening-NR.pdf.

[130] *Id.* at 1.

[131] *Id. See also* RETScreen Int'l, Case Study: Biomass Heating Project, Connecting to District Heating–Prince Edward Island (2002), *available at* http://www.biomassinnovation.ca/pdf/Case%20Studies/CaseStudy_CharlottetownDH1_PEI.pdf [hereinafter RETScreen International]

[132] RETScreen Int'l, *supra* note 132 at 1.

[133] *Id.*

[134] *See id.*

[135] *See* Aceti Associates & Industrial Economics Inc., The Massachusetts Bioheat Fuel Pilot Program 1 (2007), *available at* http://www.mass.gov/eea/docs/eea/lbe/bioheat-report.pdf.

[136] Mass. Gen. Laws Ann. *ch. 94 § 249H* $^{1}/_{2}$ *(3) (July 28, 2008).*

[137] N.Y.C., N.Y., Local Law No. 43 (2010) (amending N.Y.C. Admin. Code § 24-168.1(b).

[138] 26 U.S.C. § 25D(a) (2014).

[139] 26 U.S.C. § 45 (2014).

[140] *Id.* §45(a).

[141] *Id.* §45(c)(2) (defining 'closed-loop biomass' as any organic material from a plant which is planted exclusively for purposes of being used at a qualified facility to produce electricity).

[142] *Id.* §45(c)(3) (defining "open-loop biomass" as: (i) any agricultural livestock waste nutrients, or (ii) any solid, nonhazardous, cellulosic waste material or any lignin material which is derived from (I) any of the following forest-related resources: mill and harvesting residues, precommercial thinnings, slash, and brush; (II) solid wood waste materials, including waste pallets, crates, dunnage, manufacturing and construction wood wastes, and landscape or right-of-way tree trimmings, but not including municipal solid waste, gas derived from the biodegradation of solid waste, or paper which is commonly recycled, or (III) agriculture sources, including orchard tree crops, vineyard, grain, legumes, sugar, and other crop by-products or residues. This term does not include closed-loop biomass or biomass burned in conjunction with fossil fuel (co-firing) beyond such fossil fuel required for startup and flame stabilization). 'Wood waste' does not include pressure-treated, chemically treated, or painted wood wastes.

[143] 26 U.S.C. § 179D (2014).

[144] Energy Policy Act of 2005, Pub. L. No. 109-58, § 124, 119 Stat. 594 (2005) (codified as amended at 42 U.S.C. § 15821 (2005)).

[145] *Id.* § 125, 119 Stat. 594 (2005) (codified as amended at 42 U.S.C. § 15822 (2005)).

[146] *Welcome*, Reg'l Greenhouse Gas Initiative, http://www.rggi.org/ (last visited Dec. 22, 2014) [hereinafter RGGI].

[147] RGGI, Memorandum of Understanding 1-2 (Dec. 20, 2005), *available at* http://www.rggi.org/docs/mou_final_12_20_05.pdf.

[148] *Id.*

[149] Miguel Mendonca et al., Powering the Green Economy: The Feed-in-Tariff Handbook 155, Earthscan (Routledge 2009).

[150] N.H Rev. Stat. Ann. § 362-F:1 (2007).

[151] *Id.* § 362-F:2 (XV-a) (2012).

[152] *Id.* § 362-F:6 (V) (2012).

[153] Cal. Exec. Order No. S-06-06 (2006), *available at* http://www.dot.ca.gov/hq/energy/Exec%20Order%20S-06-06.pdf.

[154] Cal. Energy Comm'n, 2011 Bioenergy Action Plan 7 (2011), *available at* http://www.energy.ca.gov/2011publications/CEC-300-2011-001/CEC-300-2011-001-CTF.PDF.

[155] *Id.*

[156] *Id.*

[157] *Id.*

[158] *State Fuels for Schools (Green Schools),* Biomass Energy Res. Ctr., *available at* http://www.biomasscenter.org/what-we-do/our-programs/state-fuels-for-schools-%28green-schools%29.

[159] *Id.*

[160] *Vermont Fuels for Schools: An Overview* 4, BERC, *available at* http://www.biomasscenter.org/pdfs/VFFS_brochure-1.pdf.

[161] *Use Value Appraisal*, Vt. Div. of Forestry, http://www.vtfpr.org/resource/for_forres_useapp.cfm (last visited Dec. 22, 2014).

[162] Governor's Wood-to-Energy Task Force, Governor's Wood-to-Energy Task Force Report 5 (2008), *available at* http://www.maineenergysystems.com/userfiles/files/Wood%20to%20Energy%20Task%20Force%20Report.pdf.

[163] *Id.*

[164] *Id.* at 6.

[165] *Heating the Northeast*, *supra* note 1, at 19.